

A. TAGGING OF PRESSURE VESSELS, RELIEF VALVES, AND FLEXIBLE HOSES

A.1 Pressure Vessels

As required by NPD 8710.5 and NPG 1700.6A, a system of marking shall be utilized for pressure vessels and components. In compliance with national codes, all new pressure vessels, vacuum vessels and certain pressure components (e.g., separators, steam ejectors and heat exchangers) shall have the appropriate “U” or “UM” stamp required by ASME Code Section VIII. This ASME stamping shall include:

- MAWP (psi at °F),
- Minimum design metal temperature (°F at psi),
- Manufacturer serial number, and
- Codes pertaining to radiography and post weld heat treatment.

A.2 Tagging of Relief Valves

Periodic inspection and maintenance of relief valves is critical to ensure their continued functioning and assurance of operation. As required by the American Institute (API) Standards, ASME Boiler and Pressure Vessel Codes, ASME Codes for Pressure Piping (B3 series) and NPG 1700.6A, relief valves shall be periodically inspected, tested, and tagged. The FESS COTR shall ensure tags are installed on the relief device by the FESS contractor and that they contain the following information:

- Valve number,
- Set pressure, and
- Test date.

Tags shall not impede the movement or operation of the relief valve or introduce stress concentrations or notches that would compromise the vessel/component integrity.

Tagging shall be accomplished at initial installation and retagging shall be conducted during required maintenance checks. The R&CM COTR shall ensure tags are checked by the R&CM Contractor during inservice inspections and field surveys.

A.3 Tagging of flexible hoses

Flexible hoses shall be tagged at system installation with the following information:

- Unit identification,
- Test pressure, and
- Test date.

B. WAIVERS/DEVIATIONS

B.1 Waivers

Due to the invasive nature of certain hydrostatic tests, it shall be acceptable to request a waiver from a hydrostatic test. This request for a waiver may be a result of a repair when the required hydrostatic test introduces water to large sections of piping that are dry. The water introduction may result in an even greater system hazard than the one presented by the omission of the hydrostatic test itself.

Waivers from hydrostatic testing shall be submitted to the Standard Practice Engineer (SPE) by the Facility Systems Project Manager (PM) or Facility Safety Head (FSH) as appropriate. Typically, the PM shall submit the waiver if it was the result of a Construction of Facility (CoF) and by the FSH due to emergency repairs or maintenance.

Waivers shall be submitted in writing and shall include the following information:

- Date of submission,
- Outline of repair or modification conducted,
- Outline of specific hydrostatic test that is being waived, and
- Justification for waiver submittal.

If the waiver request is approved by the SPE, then a signed approved copy of the waiver shall be returned to the PM or FSH as appropriate with a copy sent to the R&CM Contractor for filing in the permanent record file.

Pneumatic testing shall be conducted when hydrostatic testing is not feasible. Specific procedures for approval and conduct of a pneumatic test, including the required establishment of a hazard zone, are found in LAPG 1710.40.

B.2 Deviations

Deviations from standards, codes, or guides, shall be submitted in writing by the PM or FSH, as appropriate, to the Pressure Systems Committee (PSC) via the PSM. As an example, a deviation shall be when a system modification does not meet the applicable code for construction (e.g., different pipe type, required radiography could not be performed or the safety factor is reduced).

The request for deviation shall include full justification for deviation, with supporting data and analysis. If the deviation is approved by the PSC, it shall be forwarded to the Executive Safety Board (ESB) for final review and approval.

The final approved deviation shall be returned to the PM or FSH as appropriate. The PSM shall forward a copy to the R&CM Contractor for inclusion within the permanent record file.

C. VISUAL INSPECTION OF PRESSURE SYSTEMS

VISUAL INSPECTION

SEC VT-10A
(An update of MPDS VT-10)
Revised:
August 1999

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1. Purpose

The purpose of this procedure shall be to establish the methods and reporting requirements for the RECERT Phases II and III visual examination of pressure systems.

2. Scope

This procedure identifies the requirements for performing a visual inspection of system piping, welds, and components.

The inspection shall consist of visual observation of exposed external portions of the piping, welds, and components. The System Inspection Plan shall specify when visual inspection of internal portions of the piping, welds, and components shall be required.

3. Visual Inspection Prerequisites

- 3.1 Personnel Certification
Personnel performing the visual inspection shall be certified in accordance with *NDES VT - 9*.
- 3.2 Component Cleanliness
The welds or components to be visually inspected shall be free of rust, grease, or surface contaminants which may obscure defects.
- 3.3 Lighting
The weld or component being visually inspected shall be illuminated to attain a minimum of 15 foot-candles. Flashlights or other auxiliary lighting shall be used to acquire the minimum illumination. There shall be no glare or shadows which would interfere with the detection anomalies.

4. Equipment

The following non-inclusive list of equipment shall be used to the extent required to perform individual inspection tasks under this procedure:

- 4.1 Illumination Equipment - Flashlights, fiberoptic cold light with fiber bundles, spot or area flood lights.
- 4.2 Vision Aids - Microscopes, jeweler's loupes, magnifiers, and coddington lenses.

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- 4.3 Measuring Devices - Scales, rules, gages, micrometers, verniers, reticules, and remote measuring borescope adapters.
- 4.4 Remote Viewing Devices - Fiberoptic or rigid borescopes, periscopes, mirrors, television, video and standard film cameras.
- 4.5 Recording Devices - Charts, drawings, video recorder or conventional film or radiographic image.

5.0 Initial Conditions

Inspections shall require the accessibility of all components and systems for complete inspection. The removal of coatings, disassembly of components or removal of insulation shall not be normally mandated. No loose debris, rust or other obstructions which may obstruct the inspection, shall be present.

6.0 Inspection Plan

The visual inspection shall be performed in accordance with an approved inspection plan. Inspection plans shall be developed by the Pressure Systems Manager and shall contain, as a minimum, the following:

- 6.1 System to be inspected.
- 6.2 Components and/or welds to be inspected.
- 6.3 Type and class of inspection to be performed.
- 6.4 Reference drawing numbers.
- 6.5 Dates for initial and follow-up inspections.

7.0 Types of Examinations

- 7.1 Direct Visual (DV) Method - This method shall be used when access is sufficient to place the eye within 24 inches of the surface to be examined and at an angle of not less than 30 degrees to the surface. Mirrors shall be used to improve the angle of vision, and aids such as magnifying lenses may be used to assist examinations. The specific part, component, vessel, or section, under immediate examination shall be illuminated with a flashlight or auxiliary lighting to attain a minimum of 15 foot-candles in order to detect small anomalies. Light intensity shall be increased to 50 foot-candles for the investigation and evaluation of suspected defects.

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- 7.2 Remote Visual (RV) Method - Remote visual inspection shall be substituted for direct examination when necessary. Remote examination shall require the use of mirrors, telescopes, borescopes, fiber optics, cameras, or other suitable instruments.

8.0 Inspection Procedure

All systems shall be inspected from all possible angles. Care shall be exercised to insure complete coverage of each system to the extent that geometry and surrounding equipment allow.

Storage vessel inspection shall consist of the observation of all portions of the pressure vessel shell, the shell penetrations, and reinforcing plates including welds, supports and foundations which are exposed to observation after fabrication. The pressure vessel boundary shall be the first weld or flange on a pipe leaving the pressure vessel, or as identified by drawing.

Weld and component inspection shall consist of observation of all portions of piping, welds, supports or components which are exposed to observation after fabrication.

9.0 Reportable Conditions

Any condition which seems to be a safety hazard shall be documented. Due to the large variety of storage vessels, piping components and ancillary equipment which may be encountered, the following shall also be reported:

- 9.1 Surface Condition - Severe rusting, corrosion, pitting, gouging, dents or other handling damage.
- 9.2 Leakage - Evidence of leakage such as stains, steam, or wetness.
- 9.3 Cracks - Cracks in any vessel, weld, or component.
- 9.4 Insulation - Loose, frayed or missing insulation.
- 9.5 Wear - Any loss of material due to mechanical interference between components or supports. The entire length of all flexible hoses shall be inspected.
- 9.6 Vibration - Evidence of any component movement in excess of 1/2 inch.
- 9.7 Fasteners - Failed, missing, damaged or undersized fasteners. Not more than one thread shall be disengaged in any nut.
- 9.8 Supports - Loose, failed or missing supports.

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- 9.9 Foundations - Broken, inadequate or shifted foundations.
- 9.10 Welds - Insufficient or excessive weld reinforcement, excessive undercut, or lack of fusion.

10. Reporting

The results of all visual examinations shall be documented and distributed to the Recertification and Configuration Management (R&CM) Contractor, the Pressure Systems Manager, and NDES facility files.

The inspection report shall include, as a minimum, the following:

- 10.1 System or components inspected.
- 10.2 Date of inspection.
- 10.3 Name of inspector with certification level.
- 10.4 Inspection results.
- 10.5 Inspection Plan Drawing Number and Item Number.
- 10.6 Inspection equipment and fixturing used so as to facilitate re-inspection as necessary.

Submitted By: _____

Date : _____

Title: _____

Approved By: _____

Date : _____

Title: _____

D. ACRONYMS

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| ANSI | American National Standards Institute |
| API | American Petroleum Institute |
| ASME | American Society of Mechanical Engineers |
| ASNT | American Society of Nondestructive Testing |
| B&PV | Boiler and Pressure Vessel |
| CAD | Computer-Aided Design |
| CCD | Configuration Controlled Document |
| CFR | Code of Federal Regulations |
| CM | Configuration Management |
| CMMS | Computerized Maintenance Management System |
| CMOL | Configuration Management On-Line |
| CNS | Change Notification Sheet |
| CoF | Construction of Facilities |
| DOL | Department of Labor |
| DOT | Department of Transportation |
| EC | Effort Code |
| FBL | Facility Baseline List |
| FC | Facility Coordinator |
| FSH | Facility Safety Head |
| IIP | Inservice Inspection Plan |
| LAPD | Langley Research Center Policy Directive |
| LAPG | Langley Research Center Procedures and Guidelines |
| LaRC | Langley Research Center |
| MAWP | Maximum Allowable Working Pressure |
| MT | Magnetic Particle Testing |
| NB | National Board |
| NBIC | National Board Inspection Code |
| NDE | Nondestructive Evaluation or Nondestructive Examination |
| NPG | NASA Procedures and Guidelines |
| NTF | National Transonic Facility |
| NTS | NASA Technical Standard |
| ORR | Operational Readiness Review |
| OSMA | Office of Safety and Mission Assurance |
| OSFA | Office of Safety and Facility Assurance |
| OSHA | Occupational Safety and Health Administration |
| PFR | Problem/Failure Report |
| PM | Facility Systems Project Manager |
| PSC | Pressure Systems Committee |
| PSCM | Pressure Systems Configuration Management |
| PSD | Pressure Systems Document |
| PSM | Pressure Systems Manager |

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| PV/S | Pressure Vessels and Pressurized Systems |
| RT | Radiographic Testing |
| SEC | Systems Engineering Competency |
| SOP | Standard Operating Procedure |
| SPE | Standard Practice Engineer |
| UT | Ultrasonic Testing |
| VT | Visual Testing |

E. DEFINITIONS

Alteration: Any change in the original manufacturer's documentation which affects the pressure-containing capability of the pressure retaining item. Non-physical changes such as an increase in the maximum allowable working or design pressures (internal or external) or design temperature of a pressure retaining item shall be considered an alteration. A reduction in minimum temperature such that additional mechanical test(s) are required shall also be considered an alteration.

Applicable Codes, Standards, Guides: Any national consensus code, standard or guide or any LaRC accepted design code, standard or guide for the design verification of pressure vessels, systems or their components. See NPD 8710.5, "NASA Safety Policy for Pressure Vessels and Pressurized Systems" and NPG 1700.6A, "Guide for Inservice Inspection of Ground-Based Pressure Vessels and Systems."

Certification: The initial documentation attesting that a pressure vessel or system is designed, fabricated, and tested in accordance with applicable codes, standards, or guides (or PSC approved deviations have been obtained) and is safe to operate at a specified pressure in a specified environment and under specified conditions.

Change Notification Sheet (CNS) (NASA Langley Form 127) (LAPG 1740.4, "Facility System Safety Analysis and Configuration Management"): A formal change notice identifying all existing Facility Baseline List (FBL) drawings (or other documents), and any new drawings/documents which are to be included in the Facility Baseline as CCD's at the conclusion of the specific project or modification.

Configuration Controlled Documents (CCD) (LAPG 1740.4, "Facility System Safety Analysis and Configuration Management"): Documents that are part of the Configuration Management system and are listed in the FBL. A working master of all drawings listed in the FBL are kept at the facility and are the responsibility of the FC.

Configuration Management On-Line (CMOL): The on-line computerized system that allows all users to view CCD drawings, the pressure systems documents, and numerous other design, operational, and facility support items. The R&CM COTR shall ensure this system is maintained by the R&CM Contractor. Other users shall submit information to the R&CM Contractor as they are noted.

Construction Managers: Individuals, assigned to the Systems Engineering Competency, who coordinate the Construction of Facilities (CoF) projects, liaison with PM, the Office of Safety and Facility Assurance (OSFA), FC, Design and Inspection Contractor, and the builder to ensure the timely completion of contract requirements.

Derating: The lowering of the maximum allowable working pressure or narrowing of the allowable operation temperature range of a pressure vessel or system.

Design Pressure: The pressure used in the design of a vessel or system for the purpose of determining the minimum permissible thickness or physical characteristics of the different parts. When applicable, static head shall be added to the design pressure to determine the thickness of any specific part of the vessel.

Design Temperature: The metal temperature used in the design of a vessel or system for determining the minimum required thickness of the components and for selecting the maximum allowable stress for the material used in the vessel or system.

Deviation: Document used to record and request acceptance of a design, fabrication, or use of a pressure vessel, piping, and associated equipment, which is not in compliance with applicable codes, standards, guides, or LaRC supplementary requirements that becomes a part of the permanent record for applicable systems or vessels. Deviations shall be approved by the Executive Safety Board.

Facility Coordinator (FC): Individual who has overall responsibility for the operations of an assigned facility.

Facility Safety Head (FSH): Individual who serves as the focal point between the facility, PSM, RECERT contractor, and PSCM contractor, for certification/recertification and inservice inspections.

Facility Systems Project Manager (PM): Individual designated to supervise and coordinate the design, fabrication, installation and initial certification of pressure vessels, pressure systems, piping, and associated equipment.

Field Surveys: Surveys used primarily on older pressure systems to identify all components within a particular high pressure system. Once completed and compiled this information shall be the basis for the component list within the recertification status sheet.

Hazardous Fluids: Gases or liquids of such a nature that a given quantity, when mixed or unmixed with air, is hazardous to personnel or equipment due to flammability, toxicity, or extremes of temperature.

Hydrostatic Test: The test of a pressure vessel or system during which the vessel or system is filled with a liquid (usually water) and pressurized to a designated level in a manner prescribed in the applicable code.

Inservice Inspection Plan (IIP): A plan for periodic inspection of a vessel, system or component while in service. If required, the vessel, system, or component shall be inoperative during the inspection. This inspection may be external or internal and use

a variety of Nondestructive examination methods (e.g. visual, magnetic particle and ultrasonic testing. See ANSI/NB-23 section RB.

Inspection Schedule: The planned inspection schedule distributed with the certification or recertification letter from the PSM. It shall indicate the type of inspection and the year in which the inspection shall be completed.

Maximum Allowable Stress: The maximum stress permissible for any specified material that shall be used in the design formulas.

Maximum Allowable Working Pressure (MAWP): The maximum gauge pressure permissible at a designated temperature for a particular vessel or system. The MAWP shall be the basis for the pressure setting of the pressure relieving devices protecting the vessel.

Maximum Operating Pressure (MOP): The highest pressure at which a system may be operated shall be called the MOP.

National Consensus Standard: Any standard, or modifications thereof, which (1) has been adopted or distributed by a nationally recognized standards producing organization under procedures whereby it can be determined by the Secretary of Labor or by the Assistant Secretary of Labor for Occupational Safety and Health that persons interested and affected by the standard have reached substantial agreement on its adoption; (2) was formulated in a manner that afforded an opportunity for diverse view to be considered; and (3) has been so designated by the Secretary or the Assistant Secretary, after consultation with other appropriate Federal Agencies. A standard, as used in this definition, shall indicate the requirements necessary and appropriate to provide a safe and healthful employment environment.

Operating or Working Temperature: The metal temperature that shall be maintained in the part of the vessel or system under consideration during normal operation.

Operating Pressure: The gauge pressure at which a vessel/system normally operates. For a vessel, it shall not exceed the MAWP and, for a system, it shall not exceed the design pressure, except for occasional variations in accordance with ASME B31.3, paragraph 302.2.4 criteria.

Permanent Record File: A compendium of all documentation regarding a particular pressure vessel or system that contains the PSD, inservice inspection reports, special inspections, test results, weld maps, radiography index, accident/incident reports, computer maintenance history report, CNSs, previous certification and recertification letters, engineering assessments, nameplate data facsimile, any National Board Forms (ANSI/NB-23, "National Board Inspection"), and other documentation as outlined in Chapter 2.

PHASE 1: The first phase of the recertification process where documentation shall be gathered, components identified, and initial non-destructive examinations performed. Initial field surveys occur in PHASE 1.

PHASE 2: The second phase of the recertification process where either additional repairs/modifications or NDE shall be completed before recertification.

PHASE 3: The third phase of the recertification process where the high pressure system has been recertified and the system shall then be periodically inspected as part of the IIP. The PSD shall be revised to reflect any changes in the system.

Pneumatic Test: A test of a pressure vessel or system in which a gas is introduced and pressurized to a designated level in a manner prescribed by the applicable code.

Pressure System: An assembly of components under pressure including vessels, piping, valves, relief devices, pumps, expansion joints, gages, etc. For the purpose of this LAPG, pressure systems at or above 150 psi shall be routinely considered high pressure.

Pressure Systems Configuration Management (PSCM) (LAPG 1740.4, "Facility System Safety Analysis and Configuration Management"): A subprogram under the Configuration Management (CM). In this subprogram, the component databases shall be constantly updated as modifications are made to the pressure systems.

Pressure Systems Document (PSD): A Configuration Controlled Document (CCD) that includes CAD produced isometric drawings of pressure systems generated as part of the certification/recertification efforts. They shall be the primary documents used to facilitate future recertification efforts. PSDs are useful to engineering and facility personnel in preparing design changes and during maintenance, repairs and system inspections. The PSD shall list all components that comprise the pressure system. Included are the recertification status sheets which tabulate the database collected during field surveys.

Pressure Systems Manager (PSM): Technical expert, designated by LaRC, for all matters involving pressure vessels/systems, their operations and related certification/recertification activities and who shall serve as the technical team leader for the Recertification Team.

Pressure Vessel: Any vessel used for the storage or handling of gas or liquid under positive pressure. Included in this definition shall be the components of systems, e. g., heat exchanger shells and drying towers, and other shell structures for which the rules of the ASME Code, Section VIII would apply.

Recertification: The procedure (appropriate tests, inspections, examination, analyses, and documentation) which qualifies a previously certified vessel or system to continue or be returned to operation for its particular service.

Recertification and Configuration Management (R&CM) Contractor: Personnel who perform field surveys, researches the MAWP for each system component, analyzes components as required, directs non-destructive examinations, and reports results to the PSM as required. They also update “redlined” CCD drawings as they are submitted in accordance with the appropriate CNS, forward finalized drawings to the Systems Engineering Competency and maintain the computerized on-line system for CNS submittals, system drawings and CCD documents.

Recertification Period: The time between recertifications when a certified status is maintained through documented periodic examinations and inspections to determine acceptable vessel or system condition as determined when the IIP is developed. The length of this period shall depend upon the results of the initial and subsequent inspection, test, and engineering analyses.

Recertification Status Sheets: These sheets shall be completed by the RECERT contractor during the PHASE 1 inspection of a specific pressure system. The sheets shall tabulate all the information known about a particular pressure system. Once completed, the sheets shall include all components of a particular pressure system, e.g., gauges, tees, unions, valves, connectors, fittings, flexible hoses, tubing, expansion joints, vessels and relief valves. Included shall be the component’s installation date, the date of inspection, MAWP, and working pressure of the system at the components location, along with a recommendation to certify, recertify, remove, repair, derate, or waive a particular component.

Repair: The work necessary to restore a pressure vessel or system to a safe and satisfactory operating condition.

Safety-Relief Device Set Pressure: The pressure, exclusive of any tolerance, at which a pressure relief device shall be set to operate.

Standard Practice Engineer (SPE): Individual designated to review and approve the design and specifications of all pressurized ground systems, and verify compliance with applicable codes, standards, guides, and supplementary requirements of these regulations.

Vacuum System: An assembly of components under vacuum (internal pressure less than that of the surrounding atmosphere) including vessels, piping, valves, relief devices, pumps, expansion joints, and gages.

Vacuum Vessel: A vessel in which the internal pressure has been reduced to a level less than that of the surrounding atmosphere.

F. REFERENCES

- a. NPD 8710.5, "NASA Safety Policy for Pressure Vessels and Pressurized Systems".
- b. NPG 1700.6A, "Guide for Inservice Inspection of Ground-Based Pressure Vessels and Systems."
- c. LAPG 1710.40, "Safety Regulations Covering Pressurized Systems".
- d. LAPG 1710.41, "Langley Research Center Standard for the Evaluation of Socket and Branch Connection Welds".
- e. LAPG 1740.4, "Facility System Safety Analysis and Configuration Management".
- f. American Petroleum Institute (API) Standards.
- g. ASME Boiler and Pressure Vessel Code.
- h. ASME Code for Pressure Piping (B31 series).
- i. ASME High Pressure Systems (1994).
- j. American Society for Nondestructive Testing (ASNT) Standards.
- k. National Board Inspection Code (ANSI/NB-23).
- l. OSHA PUB 8-1.5, "Guidelines for Pressure Vessel Safety Assessment".
- m. "Occupational Safety and Health Standards," Occupational Safety and Health Administration (OSHA), Department of Labor (DOL), 29 CFR Part 1910.
- n. Visual Inspection of Pressure Systems, Nondestructive Evaluation Section Procedure, NDES VT-10A.
- o. Nondestructive Examination, Section V, ASME Boiler and Pressure Code, current edition.
- p. Procedure NDT-ET-702, Eddy Current Inspection, ADVEX Corporation, June 5, 1990. (See Nondestructive Evaluation Section for details).
- q. Rules for Construction of Pressure Vessels, Section VIII, Division 1, ASME Boiler and Pressure Vessel Code, current document.
- r. Rules for Construction of Pressure Vessels, Section VIII, Division 2 - Alternative Rules, ASME Boiler and Pressure Vessels Code, current edition.
- s. Minutes of Meeting, NASA-Langley Pressure Systems Committee, May 9, 1988.
- t. Gianettino, D.P., Slemp, G.E., Berry, R.F., Jr., and Hudson, C.M.: "Radiographic Inspection through Asbestos Insulation," Forty-Sixth Meeting of the Mechanical Failure Prevention Group, Vibration Institute, April 9, 1992.

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